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A New Species of *Nitela* (Hymenoptera: Sphecidae: Larrinae) from Australia with Notes on the Nests and Prey of Two Species

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Abstract.—***Nitela elegans*** **Matthews**, a new species from Australia, is described and illustrated. The first biological data for *N. elegans* and *N. australiensis* Shultz, both nesting in pithy stems, are presented. Both prey on Psocoptera, and appear to progressively provision their cells. Prey of *N. elegans* were nymphs of sp. B (Psocidae) and nymphs of *Heterocaecilius* sp. (Pseudocaeciliidae). Prey of *N. australiensis* were nymphs of *Aaroniella rawlingsi* Smithers (Philotarsidae). There appear to be at least two generations per year in Canberra, Australia. The pteromalid chalcid *Eupelmophotismus pulcher* (Girault) was reared from pupae of both species. A clutch of 14 Ceraphronidae (?*Aphanogmus* sp.), possibly a hyperparasite of *E. pulcher*, was found inside a cocoon of *N. australiensis*.

Although *Nitela* Latreille is found world-wide, with 43 species listed by Bohart and Menke (1975), only three species are described from Australia, and nothing has been published on the nesting behavior of any Australian species. Smithers (1990) recorded three species of Psocoptera as prey of an unidentified Australian species listed only as *Nitela* sp., but provided no nest details. Studies of other species of *Nitela* (Iwata 1939; Janvier 1962; Valkeila 1955), indicate that members of the genus nest in pre-existing cavities in stems, galls, and beetle burrows. Cells are separated from one another with bits of woody debris piled loosely in the burrow.

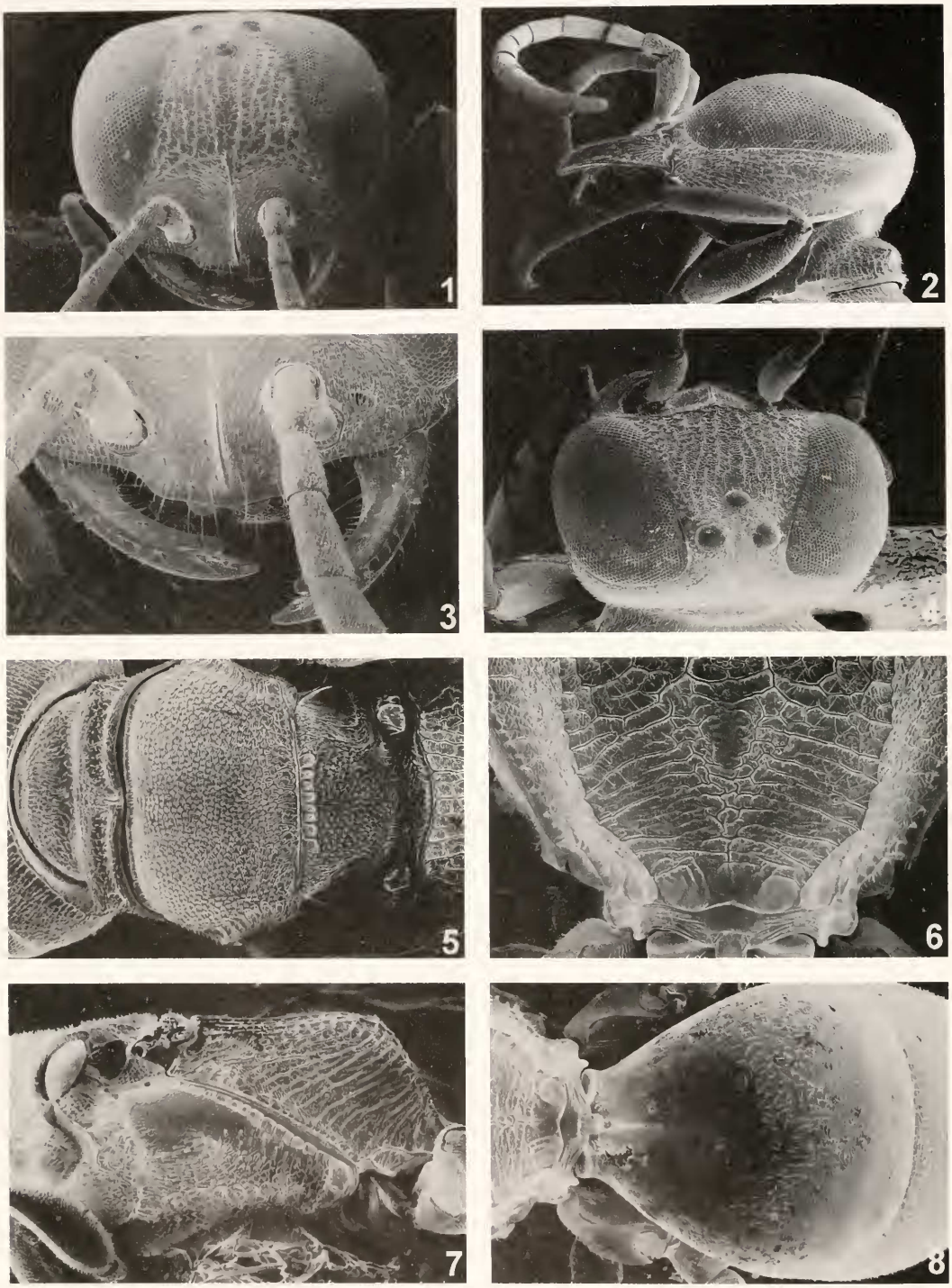
Material in the Australian National Insect Collection (ANIC) in Canberra suggests that there are several undescribed species of *Nitela* in Australia, but most are represented by only one or two specimens. In order to identify the two species discussed here, the types of each of the three named species were studied. Voucher specimens of the wasps, parasites, prey, and nests are deposited in the ANIC.

Nitela elegans Matthews, sp. nov.

(Figs. 1–8)

Types.—Holotype female, 35.19S., 148.08E., Deakin, ACT, 4 April 1999, R. W. Matthews, deposited in ANIC. Paratypes: 4 females, same locality and collector data as holotype bearing dates 20.i.1999 (Bio Note 185), 23.i.1999 (one with label Bio Note 186), and 3.iii.1999, all deposited in ANIC

Female.—*Head*: Globular, broader than high. Eyes stongly convergent dorsally, distance between eyes at level of the lateral ocelli about half distance between eyes measured just above the toruli. Frons (Fig. 1) evenly convex, rugulose, with longitudinal rugae more prominent. Vertex (Fig. 4) finely punctate, except space between lateral ocellus and orbit smooth; lateral ocelli separated by just less than their diameter, but narrowly separated from eye margin by about 0.25 their diameter. Gena (Fig. 2) finely rugulose at mandible bases, becoming faintly reticulate dorsally. Occipital carina entire, weakly costulate along anterior margin. Clypeus (Fig. 3) smooth, the apical margin rounded, very



Figs. 1–8. *Nitela elegans* Matthews, sp. nov., paratype female: 1, head, frontal view. 2, head and prothorax, lateral view. 3, clypeus, labrum, mandibles, frontal view. 4, head and pronotum, dorsal view. 5, mesoscutum and scutellum. 6, propodeum, dorsal view. 7, mesosoma, lateral view. 8, T1 dorsal view. Scale lines 0.1 mm.

slightly pointed medially, with prominent median longitudinal raised carina, evenly rounded in profile, not quite reaching clypeal margin. Labrum (Fig. 3) short, smooth broadly emarginate apically. Antennal scrobes (Fig. 1) faintly transversely microreticulate. Scape about twice as long as maximum breadth, length slightly less than length of pedicel plus first flagellar segment. Second flagellar segment 1.3× as long as first. Mandibles (Fig. 3) bidentate, the inner tooth smaller, blunter, and shorter than apical tooth. *Mesosoma*: Transverse pronotal sulcus (Fig. 5) crenulate, slightly broader laterally, discontinuous medially where it is broken by a posteriorly projecting "V"; lateral margins of pronotum weakly angulate. Mesoscutum (Fig. 5) convex,uniformly punctate, except lateral margins crenulate. Scutellum uniformly punctate, separated from mesoscutum by narrow costulate furrow. Mesopleuron (Fig. 7) subalar area coriaceous; signum deep, area below it becoming coarsely punctate; episternaulus a distinct narrow crenulate furrow; hypersternaulus distinct, broader, crenulate to rugulose, fading posteriorly; area anterior to episternaulus rugose; propodeum lateral face longitudinally strigose with weak rugulose interspaces (Fig. 7); propodeal dorsal face rugulose with longitudinal rugae more prominent; propodeal hind face (Fig. 6) less strongly rugulose, with the transverse rugae more prominent. *Metasoma*: T1 (Fig. 8) more or less smooth and shining, very faintly coriaceous dorsally, with faint transverse microreticulation towards apical margin. T2-T6 with faint transverse microreticulation. *Forewing*: Length 3.0 mm. Marginal cell distally truncate, weakly appendiculate. 1r-m vein straight, interstitial with recurrent vein, and interrupted at about 0.25 of its length. *Color*: Head, mesosoma, metasoma non-metallic black. Antennae black. Mandibles black basally, lighter apically. Legs orange, except coxae black, femora suffused with brown, and distal three tarsomeres brown to black. Wings hyaline, veins brown. *Body Length*: 5.0 mm.

Male: Unknown.

Notes.—In Turner's (1916) key this species runs to *N. kurandae* Turner. It differs in that the frons sculpture (Figs. 1, 4) is much more rugose, and the scapes and basal half of the flagellum are entirely black.

Biology.—Two active nests of this species were found in slender (ca. 5 mm diameter) pithy stems of an unknown dead plant (possibly *Lantana* sp.) on 20 and 23 January 1999 in a suburban yard of Deakin, ACT. One nest was newly initiated and the other nearly complete. The newly initiated nest was in a burrow 102 mm long and 2.0 mm in diameter. This nest contained a single half grown larva about midway along the burrow and 8 Psocoptera nymphs (sp. B, Psocidae). Two prey were adhering to the larva's body, and the others were scattered along the burrow. Those not yet fed upon were only lightly paralyzed, able to kick their legs and move their antennae, but lacked coordination. The female was resting near the entrance, head facing out. No nest structure was evident; there was no preliminary plug or cell closure.

The second nest's burrow was 136 mm long and 2.0 mm in diameter. It contained three completed cells and a fourth partially provisioned. The stem appeared previously to have been used by another wasp as the basal 36 mm of the burrow was tightly packed with pith fragments and old insect parts. Cell 1 was 12 mm long and contained a *Nitela* cocoon snug against the packed matter in the inner end of the burrow. The cylindrical tan-colored cocoon was 5 mm long and 1.8 mm in diameter. It was later found to contain a fully formed dead adult chalcidoid parasitoid, *Eupelmophotismus pulcher* (Girault) (Pteromalidae: Cleonyminae). Cell 2 was 8 mm long and contained fragments of an old cocoon. Cell 3 was 13 mm long and contained a mature larva spinning a ma-

trix of silk. Several faecal pellets adhered to the larva's body. Cell 4 was incomplete and contained 2 prey, both nymphs of *Heterocaecilius* sp. (Pseudocaeciliidae). No egg was present and both prey were lightly paralyzed and able readily to move their appendages. Beyond these prey the female was resting facing out.

The cells were separated by partitions consisting of numerous bits and pieces of organic debris, mostly not identifiable, but appearing to be small bits of bark, pith, insect exoskeleton fragments, seeds, husks, caterpillar faeces, etc. loosely packed along the burrow. The lengths of the partitions closing the three cells were 7 mm, 33 mm, and 2 mm long respectively. That cells 1 and 2 may have belonged to an older, prior nest is suggested by the fact that the cocoon in cell 2 was old and empty, the cocoon in cell one contained a dead parasite, and the closing plug of cell 2 was very long.

Both nests contained incomplete cells apparently being actively provisioned by the respective females. The first contained a partly grown larva in the cell and the second did not yet have an egg. Taken together, these facts suggest that either delayed mass provisioning or progressive provisioning is practiced in this species. Regardless, it appears that cells are not closed until the larva is essentially full grown.

The two prey species are typically found either on bark, branches, and twigs, or on the undersides of green leaves (C. N. Smithers, *in litt.*). Nine prey found in another nest (presumed to be *N. elegans*) were also identified as psocid sp. B.

The parasitoid genus *Eupelmophotismus* with about eight known species (Naumann, unpublished) is endemic to Australia and New Guinea. Previous hosts recorded for *E. pulcher* are bees, including *Hylaeus* sp., *Amphylaeus morosus* (Smith), (both Colletidae) and *Neoceratina australensis* Perkins (Anthophoridae) (Boucek 1988), and the sphecid wasp, *Psenulus interstitialis* Cameron (Matthews 2000). All of these hosts are twig nesters like *N. elegans*. Presumably *E. pulcher* oviposits through the stem wall and attacks the pupal stages of its host, although it is possible in the case of *Nitela* that it burrows through the loose cell partitions to reach its host.

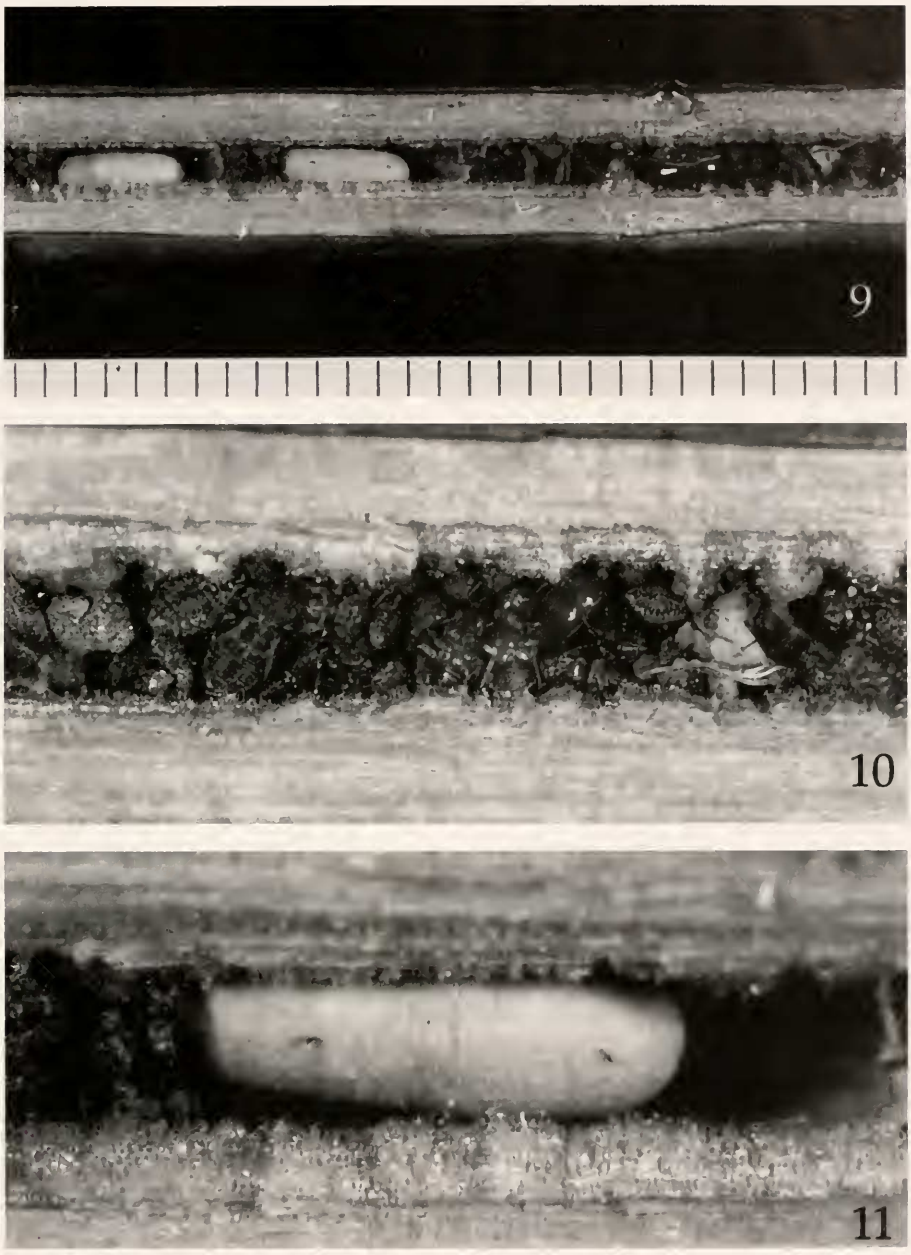
Nitela australiensis Schulz

This entirely black species of *Nitela* is widespread throughout Australia, although it has not yet been recorded from the Northern Territory.

Biology.—Turner (1916) speculated that it nested in old beetle burrows in dead eucalypts. I encountered it nesting in pithy stems of various unidentified plants in Deakin, a suburb of Canberra, ACT. Contents of three nests discovered from 31 January to 4 March 1999 are reported here.

Architecturally the nests were indistinguishable from those of *N. elegans*, being in burrows which had been excavated in slender (ca. 5–7 mm diameter) pithy stems, ranging from 27 to 96 mm long and 2 mm in diameter. From one to five cells were separated by loose aggregations of bits of organic debris, and were indistinguishable from those of *N. elegans*.

Two nests were complete when collected on 31 January 1999. One contained 5 cells, each with a typical tan-colored *Nitela* cocoon. On 27 February a single chalcid parasite (*Eupelmophotismus pulcher*) and three *N. australiensis* females were found to have emerged. One additional emerged wasp escaped. The second completed nest apparently consisted of two cells. Cell 1 contained a tan-colored *Nitela* cocoon 5.2 × 1.5 mm at the base of a short 27 mm long burrow. When later checked this cocoon was found to be moldy. One dead female adult was found among the closure debris which more or less filled the outer 20 mm of the burrow. It is likely that she had recently emerged from a second cell which had been destroyed in the process



Figs. 9–11. *Nitela australiensis* Schulz: 9, Portion of nest showing two cocoons, a mature larva, and prey separated by partitions of various lengths (scale marks are mm); 10, closeup of the 20 *Aaroniella rawlingsi* prey packed tightly in the cell; 11, cocoon, closeup, and the silk parchment-like inner lining on the partition at right, plus bits of the particles that separated the cells. Scale in 10 & 11 is the same, the cocoon is 4 mm long.

since there were *Nitela* cocoon fragments mixed among the closure particles.

The third nest (Fig. 9) collected on 4 March 1999 was incomplete and a female was found resting in the burrow. This nest, in a burrow 74 mm long and 2 mm in diameter, contained four completed cells and a fifth cell (Fig. 10) containing 20

moribund psocid nymphs packed tightly together, one with an egg attached. The egg was on one of the innermost prey affixed obliquely across the venter of the prey's thorax. It measured 1.2 by 0.3 mm. Although laid on one of the first prey items, the egg had not yet hatched. However, the larva in the preceding cell was already spinning, having consumed all the prey. This suggests that new cells are not provisioned until the larva in the previous cell is nearly full grown.

Prey were all nymphs of *Aaroniella rawlingsi* Smithers (Philotarsidae), a bark dwelling species. The delicate tan-colored cocoons (Fig. 11) in cells 1–3 all contained diapausing prepupae and were 4.0–4.5 mm long. The mature spinning larva in cell four was later found dead. Each completed cell had a thin silk or parchment-like inner closing partition to which pieces of the particles separating the cells were attached. These partitions appear to have been constructed by the mature larva during the process of forming its cocoon. Such a partition, which was always constructed in the base of the cell, may help the larva to know the proper orientation for its cocoon.

Another nest, apparently belonging to this species, was collected on 31 January 1999. It had been usurped by another cavity-nesting wasp, *Arpactophilus* sp. (Sphecidae: Pemphredoninae). The basal 33 mm of the burrow contained 4 cells with cocoons, from three of which emergence had taken place. The fourth cocoon, still intact, was opened to reveal a clutch of 14 adult ceraphronid parasites (?*Aphanogmus* sp.), probably hyperparasites of *E. pulcher*. Also present in the nest debris was a single dead *N. australiensis* female.

In the Australian National Insect Collection is a series of *N. australiensis* reared on 21 Feb. 1986 from a trap nest from Nadgee Nature Reserve, New South Wales by E. A. Sugden. This artificial burrow was 60 mm long and had a bore diameter of 4.5 mm. It contained six cells separated by coarse sawdust particles, bits of charcoal, bits of a blackish resinous substance, and small bits of frass. From this nest three females and two males had been reared (E.A. Sugden, personal communication).

It appears that there are at least two generations per year in the Canberra area. Evidence is circumstantial, based on the fact that progeny from the nest collected in late January emerged by late February, whereas progeny of the nest collected in early March had entered diapause.

DISCUSSION

The identity of the *Nitela* species mentioned by Smithers (1990) remains unknown. Associated specimens were not found in the collection of the Australian Museum. However, except for a single female of *Peripsocus milleri* (Tillyard) (Peripsocidae), the prey used by this species were all nymphs belonging to the Elipsocidae and Caeciliidae. Thus the Australian species of *Nitela*, like their congeners elsewhere in the world, specialize on Psocoptera (but see Zuijlen (1994) who notes a possible record for Zoraptera for *N. bifida* Menke from Costa Rica), primarily those groups that live on the surface of bark, with a strong preference for nymphs. Six families of psocids (Caeciliidae, Elipsocidae, Peripsocidae, Philotarsidae, Pseudocaecilidae, and Psocidae) have now been recorded as prey of Australian *Nitela*.

The provisioning data also suggest that parental investment by the female is rather extensive. Probably either progressive provisioning or delayed mass provisioning is normal in both species. At the very least, the female appears to wait to begin a new cell until the larva in the previous cell is nearly full grown. Interestingly, the two parasitoids reared from these species were both found inside the cocoon. Because parental care apparently ceases by the time the larva is full grown, perhaps it is not surprising that the cocoon stage would be the most vulnerable to parasitism.

The only record of a nest of *Nitela* from southern Africa concerns an undescribed entirely black species, 4.6 mm in length (Fred and Sarah Gess, unpublished). It was constructed in a trap nest placed vertically among dry inflorescence stems of *Berkheya* (Asteraceae) on a stream bank in the Goegap Nature Reserve, Springbok, Namaqualand in low karroid scrub. Collected on 21 October 1987, the nest burrow was 288 mm long and 6.5 mm diameter. The nest burrow was closed at both ends, with a crescent-shaped entrance at midlength. The nest had been in the field for six days when collected, and was found to have two completed cells provisioned with unidentified Psocoptera and closed with dry plant detritus and seeds. In neither cell were all the prey consumed before the larva spun a creamy-white cocoon with dense brittle walls 0.06 mm thick and rounded at both ends. A female later emerged from a cocoon that was 5.2 mm long and 2.0 mm diameter. The other cocoon (not measured) produced a male.

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